Laser Locking HF Compensation T1200477-v1

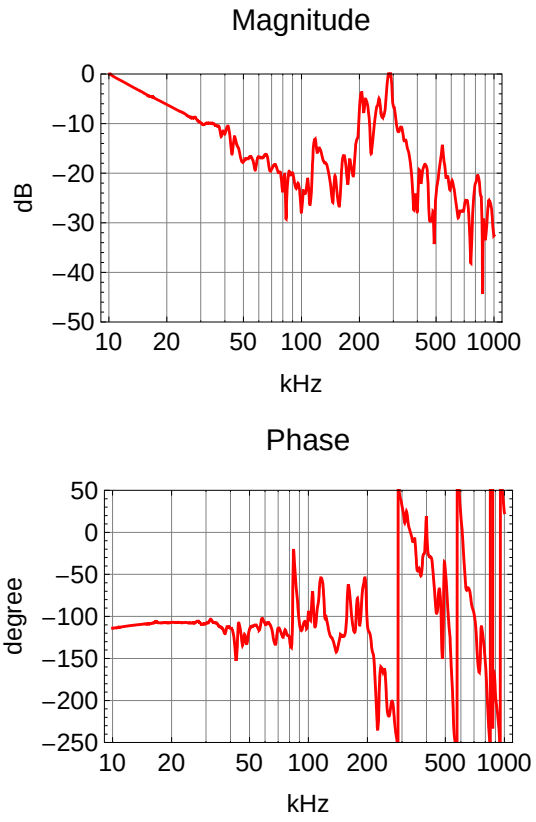
Setup

```
Needs["Controls`LinearControl`"]

$TextStyle = {FontFamily → "Helvetica", FontSize → 13};

plotopt = PlotStyle → {{Thickness [0.007], RGBColor [1, 0, 0]},
              {Thickness [0.007], RGBColor [0, 0, 1]},
              {Thickness [0.007], RGBColor [0.1, 0.7, 0.2]},
              {Thickness [0.007], RGBColor [0.5, 0.5, 0.2]}};

par[r1_, r2_] := 1/(1/r1 + 1/r2)

pole[f_, p_] := 1/(1 + i f/p)

zero[f_, p_] := 1 + i f/p

pole[f_, p_, Q_] := 1/(1 + i 1/Q f/p - (f/p)^2)

zero[f_, p_, Q_] := 1 + i 1/Q f/p - (f/p)^2
```

Read Transfer Function

```
path = "Desktop/";

oltf = {#[[1]]/1000., #[[2]] e^(i #[[3]])} & /@ Transpose[
     Append[Transpose[{#[[1]], 10^(#[[2]]/20)} & /@ Import[path <> "LL_TFmag.txt", "Table"]],
      #[[2]] ° & /@ Import[path <> "LL_TFpha.txt", "Table"]]];
oltfunc = Interpolation[oltf];
```

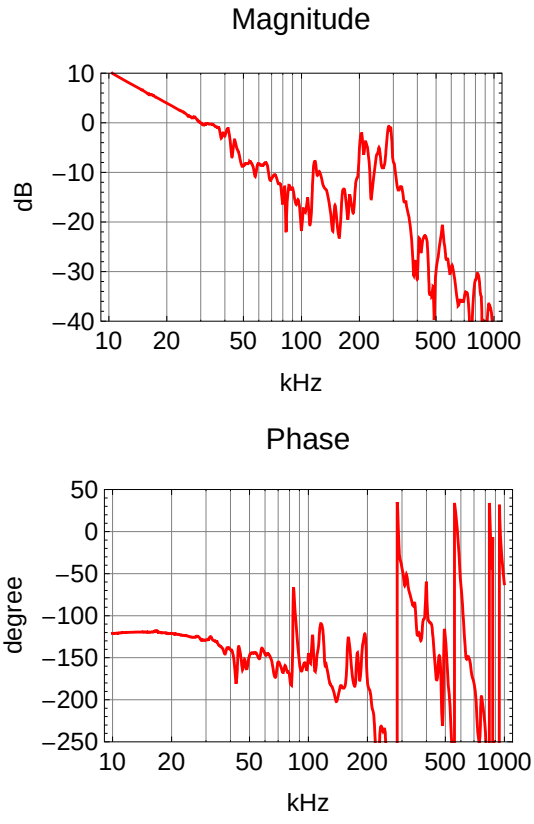
```
BodePlotEx[oltfunc[f], {f, 10, 1000}, plotopt, BaseStyle → $TextStyle,
 XAxisLabel → "kHz", MagnitudeRange → {-50, 0}, PhaseRange → {-250, 50}]
```



Target

Single pole

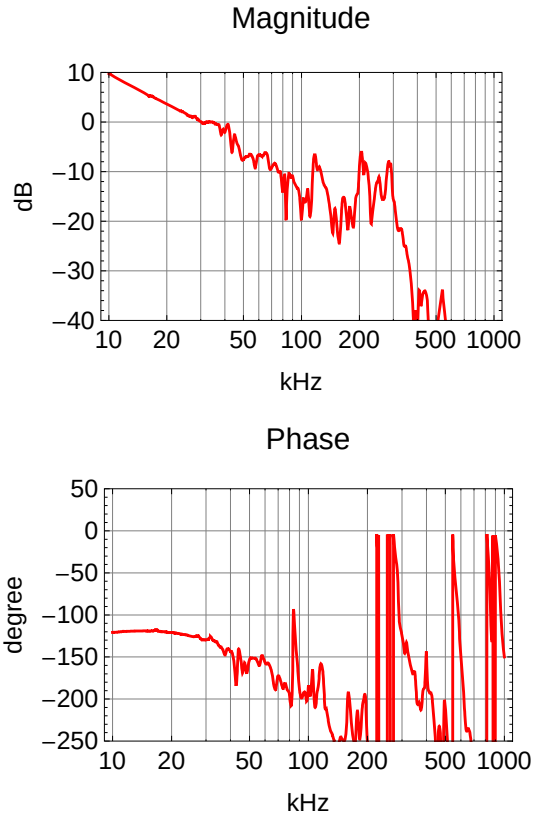
```
tf = 10^(10.4/20) pole[f, 80] oltfunc[f];
BodePlotEx[tf, {f, 10, 1000}, plotopt, BaseStyle → $TextStyle,
 XAxisLabel → "kHz", MagnitudeRange → {-40, 10}, PhaseRange → {-250, 50}]
Print["Amplitude at 30kHz = ", dB[tf /. f → 30], " dB"];
Print["Phase at 30kHz = ", Phase[tf /. f → 30] , "°"];
Print["Amplitude at 280kHz = ", dB[tf /. f → 280], " dB"];
```




```
Amplitude at 30kHz = -0.00900401 dB
Phase at 30kHz = -128.832°
Amplitude at 280kHz = -1.93569 dB
```

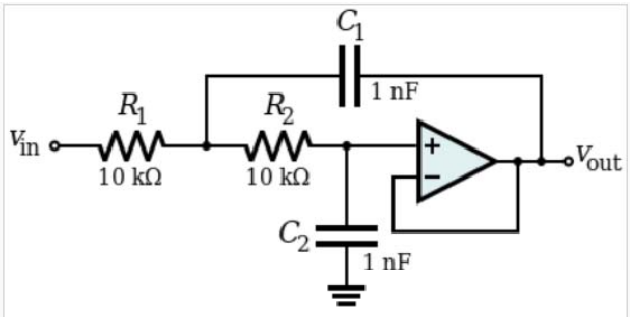
Double pole

```
tf = 10^(9.7/20) pole[f, 100, 0.85] oltfunc[f];
BodePlotEx[tf, {f, 10, 1000}, plotopt, BaseStyle → $TextStyle,
 XAxisLabel → "kHz", MagnitudeRange → {-40, 10}, PhaseRange → {-250, 50}]
Print["Amplitude at 30kHz = ", dB[tf /. f → 30], " dB"];
Print["Phase at 30kHz = ", Phase[tf /. f → 30] , "°"];
Print["Amplitude at 280kHz = ", dB[tf /. f → 280], " dB"];
```




```
Amplitude at 30kHz = 0.0730115 dB

Phase at 30kHz = -129.475°

Amplitude at 280kHz = -9.02053 dB
```

Sallen-Key



Filter components

```
SKval = {R1 → m R, R2 → R, C1 → n C, C2 → C};
```

Filter equations

```
eq1 = f0 == 1 / (2 π R C √(m n))
```

$$\text{eq1} = f0 == \frac{1}{2\,\pi\,R\,C\,\sqrt{m\,n}}$$

```
eq2 = Q == √(m n) / (m + 1)
```

$$\text{eq2} = Q == \frac{\sqrt{m\,n}}{m+1}$$

```
eq3 = n == 3.3
```

$$\text{eq3} = n == 3.3$$

```
f0 == 1 / (2 C √(m n) π R)
```

$$f0 == \frac{1}{2\,C\,\sqrt{m\,n}\,\pi\,R}$$

```
Q == √(m n) / (1 + m)
```

$$Q == \frac{\sqrt{m\,n}}{1+m}$$

```
n == 3.3
```

$$n == 3.3$$

Determine at n and m

```
msol = Chop[Solve[{eq2}, {m}] /. Q → 0.85 /. n → 3.3]
```

```
{{m → 2.08871}, {m → 0.478765}}
```

Values

```
Solve[{eq1}, {R}][[1]] /. f0 → 100*^3 /. n → 3.3 /. C → 470*^-12 /. msol
(R /. %) (m /. msol)
```

```
{{R → 1289.81}, {R → 2694.04}}
```

```
{2694.04, 1289.81}
```

Parameters

```
prm = {C1 → 1.5*^-9, C2 → 470*^-12, R1 → 2.7*^3, R2 → 1.3*^3}
1*^-3 / (2 π √(R1 R2 C1 C2)) /. prm
√(R1 R2 C1 C2) / (C2 (R1 + R2)) /. prm
```

$$\left\{C1 \to 1.5 \times 10^{-9},\ C2 \to \frac{47}{100\,000\,000\,000},\ R1 \to 2700.,\ R2 \to 1300.\right\}$$

```
101.175
```

```
0.836739
```